**Kennecott Greens Creek Site Visit November 23, 2004**

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Note: the pictures in this file have been re-sized to enable the file to be of reasonable size. They are of low resolution. A version of this report is available with high resolution pictures; it has a size of 9MB.

This site visit was conducted in conjunction with Laurie Thorpe of the USFS to look at the Tailings facility expansion area, Sulfate Reduction Monitoring Program progress, Site 960 materials removal progress and the present status of Waste Rock Site 23.

Present: USFS – Laurie Thorpe, ADEC – Kenwyn George
Greens Creek: Bill Oelklaus (site visit), SRMP discussion Pete Condon, Kerry Lear, Jennifer Saran, Bill Oelklaus.



## *Tailings Facility*

Tails were being placed to the east between the original tailings pile and the new road located on top of the slurry wall on the hillside. At the previous quarry area to the east / southeast of the site, base rock has been placed, a geotextile cover installed and covered in sand, and an initial pass of compacted tails placed. The power line to the waste water treatment plant has been relocated from adjacent to the old tails pile to a location further north on the same latitude as the treatment plant. This will enable expansion of the pile to the north.


East/southeast tailings area


Tailings expansion area

## Expansion to the south / southwest

Rock is being removed from the site for use within the tailings facility and to create an area for storm surge containment Pond 7 construction in 2005. The rock face drops approximately 20 feet from where the equipment is seen in the attached photograph, just beyond that equipment.

## Sulfate Reduction Monitoring Program (SRMP)

Prior to looking at the SRMP site a discussion was held regarding the SRMP led by Pete Condon, who had just spent the past 6 weeks with contractors and University personnel installing cells, lysimeters and sampling tubes. Previous sampling has shown that sulfate reducing bacteria (SRB's) exist in the phreatic and saturated zones of the tailings pile. This study will determine whether SRB's can exist and be promoted within the unsaturated zone (that material to be placed in future years). The study will also look at whether carbon addition will also promote bacteria that bring the metals into solution through oxidation reactions, so aggravating the metals solubility and release problem. Because different bacteria may be active over time, the study will be extended beyond the 30-month study period (through April 2006), specified in the EIS Record of Decision. The study will not be able to show what happens in decades or centuries; however laboratory tests may be able to accelerate activity to a certain degree. It is estimated from permeability tests that it will take around 6 years for interstitial water to travel from the top to the bottom of the 4-meter deep test cells.

Small "cells" comprised of admixtures within tubes will also be studied in a laboratory during the winter. At the tailings facility, cells 3m x 3m x 4m deep, lined on the sides but not the top or bottom (except for cell No 1 which is an unlined control site) have been installed at the western edge of the top of the existing pile. These cells were set on a small bench in the face of the tailings pile such that they can remain accessible as future tails are placed and the main pile rises higher beside and behind the cells. In each of the 3m x 3m cell sections there are 2 sets of 8 suction lysimeters (16 total), at various depths on opposite sides of each cell. These lysimeters will collect samples from 1.5m deep to 4m deep. In 2005 gas sampling tubes will be installed in each of these cells.


SRMP site at west edge of tails pile


SRMP – lysimeters and sample ports

Tails were excavated from 6 of the 7 cells and carbon sources ( local peat, biosolids, & spent brewery grain mash) intermixed with them adjacent to the excavations. The material was then replaced in the cells and compacted to replicate as near as possible the density of the existing tails. Lysimeter sampling points were then hand augered using a power auger (a hard job with all the friction and weight, especially for the deeper holes). Klohn-Krippen had conducted pile stability analyses with the various tails/carbon source mixtures and stated that there should be no greater than 5% by volume of any additive or combination of additives.

Cell 7 contains 10% additives, but this is just to "investigate what happens" when the carbon content is increased beyond 5%.

Core samples were also recovered from each of the 7 cells to document microbial populations and material characteristics at stratified depths in the 4-meter depth of the test cells. Over time additional cores will be taken from within the cells to look at microbiologic effects, mineralogical changes and the characteristics of interstitial waters. These core holes will have capped plastic tubes inserted in them to maintain the interstitial air integrity of the cell and study. Meanwhile samples of approximately 400 ml will be drawn from the lysimeters for interstitial water analysis. The trick will be to draw sufficient water to conduct tests, but not "overdraw" the waters to adversely influence the test such that it does not reasonably mimic what may happen in natural, undisturbed tails.

There are 7 "cells", although cell No. 1 is just undisturbed tails containing the same sampling lysimeters and core sampling as at the remaining test cells. All future sampling of the test cells will also be conducted in the Cell 1 control site.

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| Cell No. 2 | Lined cell, tailings material excavated and replaced with no additives |
| Cell No. 3 | 5% peat blended with the excavated tailings material and returned to the lined cell |
| Cell No. 4 | 2.5% peat, 2.5% brewery grain |
| Cell No. 5 | 2.5% peat, 2.5% biosolids (sludge) from the Mendenhall WWTP |
| Cell No. 6 | 1.75% peat, 1.75% biosolids, 1.75% brewery waste |
| Cell No. 7 | 3.3% peat, 3.3% biosolids, 3.3% brewery waste |

Fish waste was considered as a carbon source. This would have been very good for nutrients; however KGCMC would not be able to obtain sufficient quantities locally of the ground up fish waste. Odor and bear attractant problems would also have resulted from its use. At Kake where fish composting is being conducted, objectionable odors are noticed up to two or more miles away. Coal dust was also considered, but the carbon was not thought sufficiently bio-available (not refractory enough). Wood waste, e.g. wood chips and pulp waste were considered but were not found locally sufficiently abundant. Pulp waste would have been better than wood chips. Liquids were also considered but were not thought to be a long-term source of carbon. There are also patents in place for various liquid carbon sources that could influence the final choice of additive. The University of Waterloo does hold patents on solids additives for sulfate reduction as are being tested.

For the biosolids there are also odor problems. Another issue with biosolids handling is human health. Because peat is abundant in the area (and to a great extent already stockpiled), and adequate brewery waste is also available year-round and relatively pleasant to work with, it is possible these two products would be the preferential sources of carbon.

Infiltration rates through the "exposed" cells is thought similar to that which will occur once the cap is in place because tailings and cap hydraulic conductivities are similar at between 10% and 20% of the total precipitation. However, the exposed tailings surfaces are subject to higher oxygen levels; the saturated cap layer is designed to isolate to a great extent the tailings from the atmosphere outside the cap.

Some points discussed included additional tests that could be conducted, these being to a great extent dependent on available funding (the present study costing in the region of $200,000 annually.) These studies include placing the same or similar carbon/tailings blends in PVC tubes (say 2' diameter) in a laboratory. The tubes could be longer than the 12 foot (4-maetr) sample cells, sample ports could be installed down the side of the tube for interstitial water analysis, and temperatures could be kept the same or similar to the pile (with or without "surface effects"). With sufficient funding one could also have tubes that were saturated in the lower portion to mimic what will happen in the pile at depth. The proposed studies are for unsaturated samples.

At the tailings site, over time, additional samples could be taken from differing depths beneath the cells, possibly after sufficient information has been garnered from within the cells.

Tracers such as sodium bromide could be used to determine the rate of descent of the interstitial water (see also the discussion about cap infiltration rates later.)

## New Truck Wash facility

The old truck wash facility is located in the tailings expansion area. This old truck wash station will be removed from the site. Replacing this is a new truck wash facility being constructed at the periphery of the expansion area to the southeast. It is a more sophisticated truck wash that washes the wheels and underside with two sets of upward-pointing jets and side-mounted spray sets.


New truck wash


Vertical jets to wash tires & underside of trucks

## *Pit 5*

Rock excavation has ceased in this area. There are still rock walls, however the rock will not be quarried for use in locations around the site because it contains too much pyrite; it is better to leave it undisturbed and in place. Eventually tails will fill the pit and will be placed against these rock walls.


Waste Water Treatment Plant and Pit 5


Top rear at Site 23

## *Waste Rock Site 23*

The "valley" to the rear of the upper area of the site has been filled considerably. Class 1 material continues to be placed at the outer periphery of the pile and class 2 and 3 rock is placed in piles, and then blended to form the main part of the pile.

## Cap

The cap now has three years of healthy growth upon it and small spruce seedlings were visible on the cap. The infiltration rate is being monitored into a constructed lysimeter. Infiltration rates are higher than anticipated (now being between 15% and 20%); the reasons for this are unknown. The lysimeter chamber was sealed to try to keep up-gradient water from flowing into it. This did not significantly affect the measured infiltration rate. Presently a 10' x 20' polyethylene sheet has been placed on the cap surface to see whether local isolation of rainfall affects the infiltration rate. If little difference is noted, the polyethylene sheet will be laid further upslope. For possible consideration is the use of tracers such as sodium bromide to see what the source of water is, e.g. whether it is water flowing down slope under the cover. Infiltration response rates have been rapid after rainfall events at about 2 days, far faster than would be expected from percolation through the cover at around 2 weeks, so it is quite likely there is infiltration from water running down-slope within or beneath the cover.


Site 23 lysimeter


Polyethylene "isolation" cover (note grass growth).

## *Site 960*

Virtually all material has been removed from the site, down to natural clays. There is still acidic run-on from beneath the road above, but that is most likely from natural sources. There is also a stream that runs to the south side of the site, a portion of which now flows onto the excavated area at the lower side. Some original fill material remains in the upper access ramp area; this will be moved after the site has been found stable, and final grading completed with clean- up.


Site 960 Site 960

## *Annual reports and meeting*

The tailings and waste rock (Site 23) 2003 reports should be available in mid-December.
The Fresh Water Monitoring Program (FWMP) 2003 report should be available at the end of December.

An annual meeting is past due, this is because of the efforts being put into the SRMP. It would be possible to hold a meeting in January to go over these reports. However, the 2004 reports will be issued later in the spring of 2005, and KGCMC recommends waiting until these reports are also out before holding the meeting with various agency personnel. Many of the questions that may arise with the 2003 reports would be answered in the 2004 reports, e.g. there has been a hydro-geochemical analysis at Site 23 that will be in the 2004 report, as well as updates to the FWMP. None of the data in the 2003 report show significant or problematic changes from previous sample results. A site visit would also be better in the spring than in January for those who wished to visit the site. [Note: during a Large Mine Team teleconference on November 29 it was agreed amongst participants that under the circumstances noted above a spring meeting will be acceptable. However, future delays in annual reports and meetings is not acceptable without good cause.]

## *Other*

A power line has been laid across the Greens Creek A-Road corridor on Admiralty Island by A,E,L&P which will eventually tie-in to the main power source in Juneau. This will not occur until an underwater cable is laid from the existing Douglas Island electric grid to the Admiralty Island line. This power line will also go over to Hoonah.